November 1998 Highlights of the Pulsed Power Inertial Confinement Fusion Program

We had a total of 19 Z shots in November: 10 insulator breakdown shots, 8 dynamic hohlraum shots to optimize the energy and power coupling with nested wire arrays and with inner liners of different materials, and the first in a series of LLNL shots to measure the opacity of gold. Seven invited talks on z pinches were given at the APS Division of Plasma Physics Meeting; four by Sandia and the others by Imperial College, LANL, and LLNL. The total number of contributed talks on z pinches at the meeting was roughly double that of last year.

We conducted a series of shots on the top level of Z (Fig. 1 in the October *Highlights*) to determine the voltage limit of five Z-style, Rexolite™ insulators, each 5.72 cm high. We have confirmed excellent insulator operation at up to 4.4 MV, or 58% higher than the normal Z operating voltage and 46% above the Z design point. During the experiments, *no insulator flashover* was observed. The implications for water-line-based ZX and X-1 designs are a lower cost and greater design flexibility.

An external review of the cost, schedule, and performance of the Z/Beamlet backlighter was held. The building that will house the laser is ready for modifications, and the Beamlet components have arrived and are being stored until the building modifications are completed. Some of the issues discussed at the review included protecting the laser optics from the harsh Z environment and synchronizing the timing between the Z and Z/Beamlet pulses. In addition to viewing the dynamics of the z-pinch implosion, the backlighter (Fig. 1) will add significant diagnostic capabilities for our ICF and weapon physics experiments.

Fig. 1. Schematic of backlighting a hohlraum on Z.

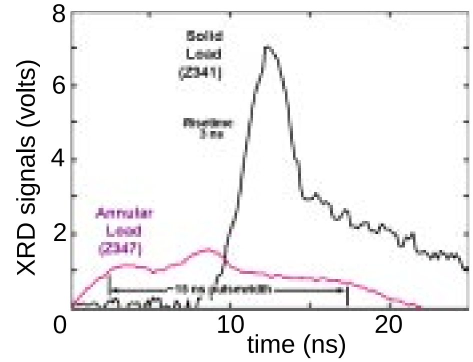

Fig. 2. On-axis emission histories from annular and solid foam targets that show components for obtaining a shaped pulse for an ICF capsule in a hohlraum.

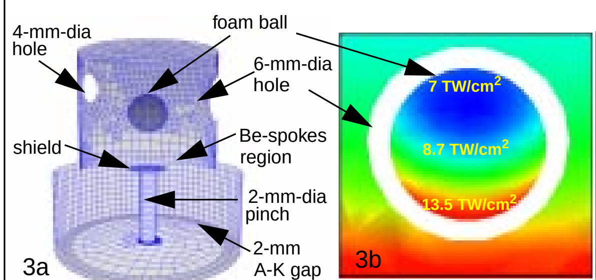

Fig. 3. a) Setup to evaluate flux distribution for ZPD hohlraum. b) Incident flux on 5-mm-dia foam ball, as seen through 6-mm-dia diagnostic hole and calculated with Lightscape. Flux on part of secondary wall is also shown. Pinch power of 150 TW is assumed.

The dynamic hohlraum optimization series on Z included a demonstration of the control of the shape of a radiation pulse in the hohlraum. The results of two shots (Fig. 2) show the potential to control the on-axis radiation drive to an ablatively-driven ICF capsule within a dynamic or on-axis hohlraum. The radiation emission history for the annular load is reminiscent of the shape required for the foot of the pulse to drive the capsule, while the emission from the solid foam target is more like that required for the peak of the drive pulse. In subsequent experiments, we will superimpose the “foot” and “peak” components in a more definitive attempt to control radiation time history.

The radiation distribution in a z-pinch-driven (ZPD) hohlraum and an attached, end-on secondary has been modeled with Lightscape™ to prepare for foam ball illumination experiments in December (Fig. 3). The foam ball, a diagnostic to evaluate the illumination asymmetry for comparison with LASNEX calculations, is backlit by x rays emitted from the secondary wall. The region between the primary and secondary, which contains beryllium spokes, is modeled as partially transmissive and reflective. In this single-sided radiation drive configuration, the flux incident on the ball in Lightscape is strongly axially dependent as viewed through the diagnostic hole. Similar calculations by LLNL with the Gerdie code for a double-sided drive configuration--that is, with two separate primaries, each containing a z-pinch source--predict adequate symmetry for a high-yield ICF capsule in the secondary.

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